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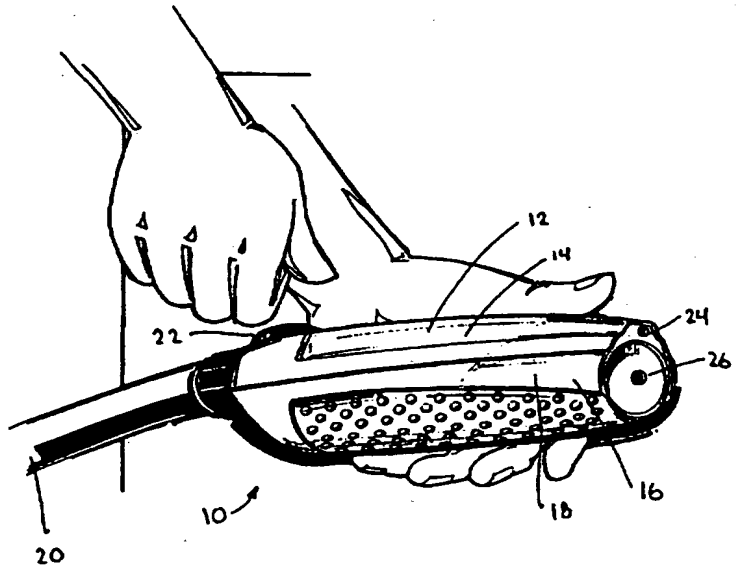

(57) Abstract

A no scrub/no wipe method for cleaning exterior windows without filming or spotting includes spraying a cleaning composition onto the window surface, preparing purified rinse water by passing rinse water through an ion exchange resin and rinsing the window surface with the purified rinse water. A spray gun (12) comprising separate chambers for the cleaning composition (14) and the ion exchange resin (16) is disclosed.

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CLEANING COMPOSITION, METHOD AND APPARATUS FOR CLEANING EXTERIOR WINDOWS

BACKGROUND OF THE INVENTION

(i) Field of the Invention

The present invention relates to a composition and a related method and apparatus for cleaning exterior windows in which the cleaning composition is applied to the surface and then the surface is rinsed with water.

(ii) Description of Related Art

Glass cleaning compositions are disclosed in U.S. Patent Nos. 3,819,522; 3,915,738; 4,213,873; 4,315,828; and 5,454,983. The '522 patent discloses a non-fogging window cleaner containing 0.1 to 3% of an anti-fogging surfactant mixture including a mixture of a nonionic surface active agent and an anionic or nonionic surfactant. The '738 patent discloses an aqueous cleaning composition containing water and a catalytically effective amount of a catalyst, an optional surface active agent with or without a water softening agent. The '873 and '828 patents disclose a water based cleaning composition including a major amount of water and a minor amount of a cleaning agent such as ammonium hydroxide or a lower alcohol such as isopranol and a small amount of a polyethylene glycol of high molecular weight and/or a lubricity component. The '983 patent discloses an aqueous detergent composition containing zwitterionic and cationic detergent surfactants and solvents and/or buffers. Such cleaning compositions are typically applied to a glass surface and wiped off with an absorbent material or squeegee.

Three commercially available cleaners applied to a surface via a hose end sprayer and which require no wiping are "Exterior Window Wash" sold by "BIX™" located in Ashland, Tennessee, "renz e-z™" sold by Remwood Products Company located in Tulsa, Oklahoma and "Windex Outdoor™" sold by S.C. Johnson Wax located in Racine, Wisconsin. These products rely on force of blast of the wash and rinse steps. A major drawback associated with cleaning glass surfaces by employing such cleaning compositions and rinse water,

particularly windows, has been the formation of an undesirable, residual hard water film or spots after the rinse step. The residual hard water film or spots tend to form in some cases even if the rinse water has a low degree of hardness depending on factors such as the size, age or condition of the window. For example, very bad filming has been observed when the rinse water has only 35 ppm of $CaCO_3$. The present invention seeks to overcome that and other drawbacks.

SUMMARY OF THE INVENTION:

A first object of the invention is to provide a composition for cleaning exterior windows that is effective in combination with water.

Another object of the invention is to provide a composition for cleaning exterior windows that is non-toxic to animals and plants.

Yet another object of the invention is to provide a method for cleaning exterior windows with the composition of the present invention in combination with water.

Still another object of the invention is to provide a method for cleaning windows located above the ground floor of a structure without having to remove screens and engage in other cumbersome procedures. The method can include a rinse step which provides a visual indication of when rinsing is completed due to beading of the rinse water on the glass surface.

A further object of the invention is to provide a method for cleaning a surface such as glass that requires no wiping.

Another object of the invention is to provide a method for cleaning a surface such as glass without leaving an undesirable residual hard water film or spotting on the surface.

According to one embodiment, the present invention provides a powdered cleaning composition for cleaning a glass surface comprising (i) 15 to 60, preferably 30% by weight of tetrasodium EDTA; (ii) 15 to 60, preferably about 30% by weight of tetrapotassium pyrophosphate; (iii) about 15 to 60, preferably

about 30% by weight of sodium carbonate; (iv) 2.5 to 10, preferably about 5% by weight of an ethoxylated alcohol surfactant; and (v) about 2.5 to 10, preferably about 5% by weight of an ethoxylated quaternary surfactant.

According to another embodiment, the present invention provides an aqueous cleaning composition for cleaning a glass surface comprising (i) 1 to 10, preferably 2 to 7% by weight on a dry basis of tetrasodium EDTA; (ii) 1 to 20, preferably about 5 to 15% by weight on a dry basis of tetrapotassium pyrophosphate; (iii) about 1 to 10, preferably about 5 to 8% by weight on a dry basis of sodium xylene sulfonate; (iv) 0.1 to 10, preferably about 3 to 7% by weight of at least one ethoxylated alcohol surfactant; (v) at least about 0.1% of a cationic surfactant, preferably about 0.5 to 3% by weight ethoxylated quaternary surfactant; and (vi) 48 to 97% by weight of water, preferably about 70 to 80% water.

According to another embodiment, the present invention provides a method for cleaning a glass surface comprising spraying a cleaning composition mixed with water on the surface; preparing purified rinse water by passing rinse water over an ion exchange resin; and rinsing the surface with the purified rinse water. The cleaning composition can be in the form of a highly built liquid, slurry or solid detergent which is mixed with the water and applied to the glass surface as an aqueous solution.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 illustrates a hand held, hose end spray gun that can be used in the method of the invention;

Figure 2 depicts how the spray gun shown in Figure 1 can be used to carry out the method of the invention to clean windows on a building structure;

Figures 3 a-c illustrate side, top and front views, respectively, of another embodiment of a hand-held, hose end spray gun useful for cleaning and rinsing a surface to be cleaned in accordance with the invention;

Figures 4 a-c illustrate side, top and front views, respectively, of the main body of the spray gun of Figures 3 a-c;

Figures 5 a-b illustrate a base and a cap of an ion exchange resin cartridge of the spray gun of Figures 3 a-c;

Figure 6 illustrates an assembly of the base and cap of the cartridge of Figures 5 a-b;

Figures 7 a-c illustrate side, top and front views, respectively, of a spray gun having a modified ion exchange resin cartridge in accordance with the invention;

Figure 8 illustrates an assembly of the base and cap of the cartridge of Figures 7 a-b;

Figures 9 a-b illustrate side and front views, respectively, of a modified spray gun having an ion exchange resin compartment in the main body in accordance with another embodiment of the invention; and

Figure 10 illustrates details of the spray gun shown in Figure 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

The invention provides an exterior window wash system which can clean outside windows and glass quickly and easily without spotting. The invention overcomes disadvantages of the labor intensive method of cleaning windows which requires climbing on ladders, scrubbing and wiping or using a squeegee. According to the invention, windows can be cleaned and rinsed with an easy-to-use device. The device is capable of removing dirt, smudges, bird droppings and/or hard water spots to leave behind clear, sparkling clean glass. The device attaches to a garden hose and the device includes a valve for selective spraying of the cleaning composition or rinse water. With the valve in the "clean" position, water mixes with the cleaning composition inside the sprayer to allow cleaning of windows without scrubbing. The cleaning solution can be allowed to remain on the window for a suitable time period but preferably does not dry and can range from 10 seconds to 1 minute. With the valve in the "rinse" position,

rinse water passes through the sprayer, is filtered to remove the hardness and/or other residues that causes spotting and/or filming and after rinsing the window, the glass dries to a clean and beautiful finish without the need for wiping or using a squeegee.

The cleaning composition used according to the present invention can take various forms such as in the form of a liquid, slurry, or solid such as a loose or compacted powder. Preferably, the cleaning composition is a heavily built detergent and preferably contains low foam surfactants. For instance, the cleaner can include organic and inorganic builders. However, it is desirable that the cleaner be non-hazardous in that it is caustic-free, acid-free and/or solvent-free. Further, it is desirable that the detergent include an ingredient which provides a visual indication of when the rinsing step is completed. According to a preferred embodiment, the cleaning composition includes a rinse indicator such as an ethoxylated quaternary surfactant which causes the rinse water to bead up when sufficient rinsing has been completed.

The cleaning composition can include at least one inorganic builder such as orthophosphates (e.g., monobasic, dibasic or tribasic phosphates including sodium or potassium salts), polyphosphates (e.g., sodium or potassium phosphates such as tripolyphosphate, pyrophosphate, pentaphosphate, hexametaphosphate, etc.), non-phosphorous alkaline sodium and potassium salts (e.g., silicates, carbonates, borates, bicarbonates, sesquicarbonates, tetraborates, etc.), or the like. A preferred phosphate builder is tetrapotassium pyrophosphate (TKPP). The foregoing ingredients can be used alone or in combination with or without additional inorganic builders.

The cleaner can include at least one organic builder such as an amino acid type builder (e.g., amino acetates or nitriloacetates such as ethylenediamine tetraacetic acid (EDTA), tetrasodium EDTA, nitrilotriacetates such as trisodium nitrilotriacetate (NTA), glycinates such as glycine, etc.), carbohydrate type builder (e.g., sugars such as succinates or gluconates, etc.), polycarboxylates (e.g., polyacrylic acid salts, citric acid, etc.), polyphophonates (e.g., Dequest

2000™ series builders available from Monsanto Co., etc.), and the like. Ethylenediamine tetraacetic acid tetrasodium salt (EDTA) is an especially preferred organic builder. For example, the tetrasodium salt aqueous solution sold by Dow Chemical Company under the tradename Versene 100 is an especially preferred organic builder. The foregoing organic builders can be used alone or in combination with or without additional organic builders.

The cleaner can include at least one surfactant providing wetting and optionally low foaming characteristics such as non-ionic, anionic, cationic and amphoteric surfactants. The preferred surfactants are nonionic compounds and in particular a mixture of ethoxylated alcohols has been found to be particularly effective. For example, the surfactants can comprise a mixture of alcohols sold by Shell Oil Company under the tradenames Neodol 91-6 and Neodol 91-2.5. Neodol 91-6 is a mixture of alcohols containing 9 to 11 carbon atoms with an average of 6 moles of ethylene oxide reacted onto the hydroxyl portion of the alcohols. Neodol 91-2.5 is a mixture of alcohols containing 9 to 11 carbon atoms with an average of 2.5 moles of ethylene oxide reacted onto the hydroxyl portion of the alcohols. The surfactants can be used alone or in combination. Neodol 91-6 and Neodol 91-2.5 are particularly effective when used in combination.

The cleaning composition can include a coupling agent such as an anionic coupling agent (e.g., aromatic sulfonates such as sodium xylene sulfonate, sodium alkyl napthnlene sulfonates, phosphate esters, alkyl sulfate, etc.), an amphoteric coupling agent (e.g., imidazolines, alkylamphocarboxyglycinates and alkylamphocarboxy-propionates in their mono and dicarboxylo forms, alkyl betaines, amine oxides, etc.), cationic surfactants (e.g., ethoxylates quaternary ammonium compounds, etc.), or the like. A preferred coupling agent is a hydrotrope such as sodium xylene sulfonate (SXS). A particularly preferred form of SXS is SXS-40, which is a 40% solution of SXS in water. SXS-40 is sold by Stepan Company under the tradenames STEPANATE SXS™ and similar products sold by Pilot (Pilot SXS-40) and Witco (Witconate SXS liquid, Petro

BA and Petro AA). The coupling agent minimizes phase separation of the surfactant from the builder.

For purposes of conserving purified rinse water and thus prolonging the usefulness of the ion exchange resin, the cleaner can include a rinse indicator such as at least one cationic surfactant which causes beading of the rinse water on the glass surface being cleaned. One preferred cationic surfactant is an ethyoxlated quaternary surfactant such as Q-17-2 sold by Exxon's Tomah division. The cationic surfactant aids rinsing by causing the rinse water to bead up when rinsing is completed. However, any cationic surfactant soluble or dispersible in a highly built formula can also be used. The foregoing surfactants can be used alone or in combination with each other with or without additional surfactants.

If desired, the cleaning composition can include optional components such as corrosion inhibitors for glass and/or metal (e.g., aluminum, copper, steel, galvanized surfaces, etc.), odorants, disinfectants, anti-fogging agents, solvents, water softening agents, suspension agents, etc. However, in order to avoid damage to metal surfaces surrounding the glass surfaces to be cleaned, it is preferable that the cleaning composition be acid-free and/or caustic-free in order to avoid attack of such metal surfaces by the cleaning composition. A preferred corrosion inhibitor is a sodium silicate such as sodium meta silicate pentahydrate ($SMS \cdot 5H_2O$), which is an aluminum corrosion inhibitor.

The cleaning composition according to one embodiment of the present invention comprises a loose or compacted powder which includes about 15 to 60, preferably about 30% by weight of tetrasodium EDTA; about 15 to 60, preferably about 30% by weight of tetrapotassium pyrophosphate; about 15 to 60, preferably about 30% by weight of sodium carbonate (preferably in the low density form); about 2.5 to 10, preferably about 5% by weight of ethoxylated alcohol surfactants; and about 2.5 to 10, preferably about 5% by weight of ethoxylated quaternary surfactant. In this composition, the tetrasodium EDTA and tetrapotassium pyrophosphate synergistically combine to remove high silicate

dirt type soil, which is the most common form of soil found on home exterior windows. The sodium carbonate aids in the removal of grease and oils, particularly from body oils such as fingerprints. It also acts as a filler that lowers the cost of the composition and facilities compression of the cleaning composition in pellet form. The ethoxylated alcohol surfactant assists in the removal of body oils such as fingerprints. It also achieves wetting of a glass surface so that even cleaning is achieved. The ethoxylated quaternary surfactant serves as a rinse indicator that allows the user to know when enough purified rinse water has been applied to the surface. It is important from a cost perspective to avoid using more purified rinse water than necessary because the ion exchange resin, which purifies the rinse water, will last longer if it only processes the minimum amount of rinse water necessary for a given application.

When applied in combination with water, the powdered cleaning composition of the invention can be used in solid form, such as a pellet, to allow the water to dissolve it. The pellet can be compressed in a shape that is compatible with a hand held hose end sprayer apparatus from which it is dispersed.

In another embodiment, the cleaning composition is in a liquid or semi-liquid form which is mixed with water and sprayed onto a window by a hand-held hose-end sprayer. For instance, the cleaner can be in the form of an aqueous solution which is withdrawn from a container via suction and admixed with water from a garden hose via a closed venturi or aspirator type of sprayer.

The method of the invention comprises cleaning a surface by applying a cleaning composition in combination with water to the surface, passing rinse water through an ion exchange resin to purify it, and rinsing the surface with the purified water. The method of the invention is particularly effective in removing dirt, smudges, bird droppings, and hard water spots from glass surfaces such as the exterior surfaces of outdoor windows.

Factors that affect how clean a window is after rinsing include the effectiveness of the cleaning step, the size of the windows, the weather

conditions at the time of cleaning, and the quality of the rinse water. A significant advantage of the method of the invention is in eliminating or reducing the formation of an undesirable, residual hard water film or spots on the surface that has been cleaned. This is achieved by removing the hardness of the rinse water by first passing the rinse water through an ion exchange resin such as a bed of ion exchange resin particles.

The cleaning composition according to another embodiment of the present invention comprises an aqueous cleaning composition. The aqueous cleaning composition can include 40 to 75%, preferably about 50-65% by weight of water; 5 to 30%, preferably about 10-20% by weight of a 40% solution of ethylenediaminetetraacetate tetrasodium salt in water (EDTA such as Versene 100); 2 to 20%, preferably 5-15% by weight of inorganic builder such as tetrapotassium pyrophosphate (TKPP); 0.5 to 10% of at least one ethoxylated alcohol surfactant, preferably about 1 to 5% by weight of a mixture of alcohols containing 9 to 11 carbon atoms with an average of 6 moles of ethylene oxide reacted into the hydroxyl portion of the alcohols (Neodol 91-6) and about 1 to 5% by weight of a mixture of alcohols containing 9 to 11 carbon atoms with an average of 2.5 moles of ethylene oxide reacted onto the hydroxyl portion of the alcohols (Neodol 91-2.5); 5 to 30%, preferably about 10 to 20% by weight of a 40% solution of SXS in water (SXS-40); and at least about 0.1% of a cationic surfactant, preferably about 0.5 to 3% by weight of an ethoxylated quaternary surfactant. An especially preferred aqueous cleaning composition is as follows:

13.6%	Versene 100
9%	TKPP
2%	Neodol 91-6
2%	Neodol 91-2.5
15%	SXS-40
1%	Tomah Q-17-2
58.4%	Water

The ion exchange resin used in the method of the invention can be of the cationic, anionic, and preferably of the mixed bed type, such as a blend of cationic and anionic resins. The ion exchange resin may contain various particle sizes or the resin can have a narrow particle size distribution.

The method of the invention is preferably used to clean glass surfaces such as windows. The method of the invention, however, can be used to clean other surfaces such as mirrors, polished stone, ceramic, painted surfaces such as vehicles, or other shiny surfaces.

It is preferable to have a time interval between the steps of applying the cleaning composition and applying the purified rinse water to the surface. The preferred practice is to apply the cleaning composition and wait 10 seconds to 1 minute before applying the purified rinse water. However, the cleaning composition could be removed by water from any source at any time such as during a rainstorm.

One or more applicator devices such as hose-end, hand-held spray guns can be used to practice the method of the invention. For example, one spray gun could apply the cleaner and another spray gun could apply the water rinse. For instance, spray guns which could be modified to include chambers for holding the ion exchange resin and/or the powdered or liquid cleaning composition can be found in commonly owned U.S. Patent Nos. 5,605,578; 5,595,345; and 5,567,747 and commonly owned and copending application Serial Number 08/651,952. Preferably, the applicator device includes separate chambers for the cleaner and ion exchange resin. Such spray guns can be attached to the end of a garden hose to receive water for performing the cleaning step by combining the cleaning composition with water and spraying the mixture on a surface to be cleaned. The spray gun can also be used for performing the rinse step.

In a preferred embodiment of the invention, the applicator device has a compartment for containing a cleaning composition and a separate compartment for containing an ion exchange resin. With this kind of applicator device, a valve can be used to direct incoming water from a garden hose to either

compartment depending on which step of the method of the invention is being carried out. However, the applicator device can include suitable attachments for connection to containers/sources of the cleaning composition and ion-exchanged rinse water.

In practicing the method of the invention to clean glass, the cleaning solution along with the force of the blast of the water hitting the glass can clean a window and the ethoxylated quaternary surfactant can form an invisible film on the glass. This film will cause the glass to bead water when the purified rinse water is applied. When the water beads on the glass, the user knows that enough purified rinse water has been applied to the window to remove the cleaning composition without spotting and/or filming. Thus, the excess use of purified rinse water can be avoided and the life of the exchange resin can be maximized allowing more windows to be cleaned before replacement of the exchange resin. In this way, a smaller and thus more economical spray gun can be manufactured for consumer use.

An applicator device in accordance with one embodiment of the invention is shown in Figure 1. The applicator 10 has a compartment 12 for containing the cleaning composition 14 and a compartment 16 for containing the ion exchange resin 18. The applicator device can be connected to a garden hose 20. A valve 22 will allow the user to direct the incoming water through either compartment 12 or 16, depending on whether the cleaning or rinsing step is being carried out.

When the valve 22 is in the "Clean" position, the incoming water from the hose 20 will mix with the cleaning composition 14 inside compartment 12 to permit cleaning of a surface without scrubbing. In that mode, the mixture of water and cleaning solution will exit through opening 24. When the valve 22 is switched to the "Rinse" position, the incoming water from the hose 20 will pass through the ion exchange resin 18 in compartment 16 and exit through opening 26. As the incoming water passes through the ion exchange resin 18 in compartment 16, it is treated to remove the hardness and other residues that

cause spotting. Thus, the glass rinsed with the purified water can dry to a clean finish without wiping or using another device such as a squeegee.

Figure 2 illustrates how the applicator device 10 can be used to employ the composition and method of the invention to clean surfaces such as glass windows above ground level without having to use ladders and scrub or wipe the windows.

Figures 3 a-c illustrate side, top and front views, respectively, of a hand-held, hose end spray gun 28 useful for cleaning and rinsing a surface to be cleaned in accordance with the invention. The spray gun includes a main body 30 and an ion exchange cartridge 32. The main body includes an inlet 34 for attachment to a garden hose 36 and an inlet 38 for attachment to a container 40 holding a liquid detergent composition withdrawn from the container by suction through suction tube 42. A valve 44 includes passages (not shown) for selectively allowing water from the garden hose to pass through the ion exchange cartridge or pass directly through the main body so as to mix with the liquid detergent. For this purpose, the main body includes an outlet 46 communicating with the inlet 48 of the cartridge. The inlet 48 is located on a projection 50 sealed in a bore 52 in the main body by an O-ring 54. The inlet 48 is in fluid communication with a series of passages 56, 58, 60, 62, 64, 66 filled with particles of an ion exchange resin 68.

As shown in Figure 3b, the cartridge 32 is cylindrical in shape and the passages 56-66 are progressively larger in cross section and volume towards the middle of the cartridge. In order to hold the cartridge in place, the main body includes tabs 76, 78 which engage shoulders 80, 82. The cartridge includes a cap 84 and a base 86, the base including a T-shaped slot receiving a mating T-shaped portion of the main body, as shown in Figure 3c. With this arrangement, the cartridge 32 can be replaced when the ion exchange resin particles are depleted and no longer adequately perform their ion exchanging function.

Figures 4 a-c illustrate side, top and front views, respectively, of the main body 30 of the spray gun 28. As shown in Figure 4a, the main body includes an

opening 92, an upstream passage 94, a downstream passage 96, a supply passage 98, a bore 100 and an outlet 102. The bore 100 receives an outlet end of the suction tube 42 and liquid detergent is siphoned into the downstream passage 96 due to a closed venturi effect when water from the hose 36 passes from the upstream passage 94 into the downstream passage 96. As a result, when the valve 44 is in a cleaning position, water is supplied to the opening 92 and liquid detergent is mixed with water and sprayed through the outlet 102.

Figures 5 a-b illustrate details of the base 86 and the cap 84 of the ion exchange resin cartridge 32 of the spray gun 28. The base includes partitions 104, 106, 108 and the cap 84 includes a series of grooves 110, 112, 114 receiving edges of the partitions 104-108. The cap 84 also includes partitions 116, 118. When the cap and base are assembled, as shown in Figure 6, the partitions provide a flow path which directs the water entering inlet 48 upwardly and over an upper edge of partition 104, downwardly between partitions 104 and 116, under a lower edge of partition 116, upwardly between partitions 116 and 106, and so on. Although six passages 56-66 are shown, any suitable arrangement of flow passages can be used in accordance with the invention.

Figures 7 a-c illustrate side, top and front views, respectively, of a spray gun having a modified ion exchange resin cartridge 120 in accordance with the invention and Figure 8 shows details of the cartridge 120. As shown, the main body 30 is the same as shown in Figures 3-6 but the cartridge has a different flow passage arrangement for purposes of obtaining more effective treatment of the water in order to remove the hardness thereof. In particular, the cartridge includes upward flow passages 122, 124, 126, 128, 130 and downward flow passages 132, 134, 136 138 formed by partitions 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160. As shown, the upward flow passages 122-130 are larger in cross section and volume than the downward flow passages 132, 134, 136, 138, 140. For example, the closely spaced portions forming the downward flow passages can be less than 0.10 inch apart. It is believed that the ion exchange resin is more effective in removing the hardness of the water when the

water is flowing against gravity since this would reduce channeling of the water to be treated through the resin. As such, the modified cartridge provides a more effective and efficient arrangement of the ion exchange resin particles.

Figures 9 a-b illustrate side and front views, respectively, of a modified spray gun 170 having an ion exchange resin compartment built into a main body 172 in accordance with another embodiment of the invention. The main body 172 includes an inlet 174 for attachment to a garden hose and an inlet 176 for attachment to a container holding a liquid detergent composition which is withdrawn from the container by suction through a suction tube. A valve 200 includes passages for selectively allowing water from the garden hose to pass through an ion exchange resin compartment 180 comprised of three sequential flow passages 182, 184, 186 or pass directly through the main body 172 so as to mix with the liquid detergent. For this purpose, the main body includes a passage 188 directly communicating with the flow passage 182 which in turn communicates with flow passages 184 and 186, all of which are filled with the ion exchange resin.

As shown in Figure 9a, the main body 172 includes an upstream passage 190, a downstream passage 192, a supply passage 194, a bore 196 and an outlet 198. The bore 196 receives an outlet end of the suction tube and liquid detergent is siphoned into the downstream passage 192 due to a closed venturi effect when water from the hose passes through the upstream passage 190 into the downstream passage 192. As a result, when valve 200 is in a cleaning position, water is supplied to the passage 190 and liquid detergent is mixed with water and sprayed through the outlet 198. For rinsing, the valve is turned to a rinse position and water from the hose is passed through the series of passages 182-186 filled with the ion exchange resin and the purified water is sprayed from outlet 202 to rinse the cleaned window. Although three passages 182-186 are shown, any suitable arrangement of flow passages can be used in accordance with the invention.

Figure 10 illustrates details of the spray gun shown in Figure 1 having an ion exchange resin compartment 210 and a compartment 212 holding a cleaning composition built into a main body 220. The main body 220 includes an inlet 222 for attachment to a garden hose, an outlet 224 for spraying a mixture of water and cleaner and an outlet 226 for spraying rinse water. When valve 230 is in a rinse position, a passage 232 allows water from the garden hose to pass through the ion exchange resin compartment 210. The deionizer compartment includes a series of baffles 214 (only three of which are shown) and particles of an ion exchange resin 216 between the baffles. When the valve 230 is in a cleaning position, a passage 234 allows water to pass through the cleaner compartment 212 so as to mix with the cleaning composition which can be provided in the form of pellets 218. The main body 220 includes a passage 236 communicating with the ion exchange resin compartment 210 and a flow passage 238 communicating with the cleaner compartment 212. A flow passage 240 in the main body selectively supplies water to passages 232, 234 in the valve depending on the position of the valve.

The size of the chamber holding the ion exchange resin was found to affect the efficiency of the resin in removing the hardness of the rinse water. In particular, it was found that longer and more narrow chambers were more efficient than short and wide chambers. In the following tests, A represents a 17 inch long and 1.25 inch diameter chamber holding 300 grams of resin, B represents a 9 inch long and 2 inch diameter chamber holding 260 grams of resin and C represents an 8 inch long and 3 inch diameter chamber holding 280 grams of resin. In the following results, the rinse water had a hardness of about 290 ppm as $CaCO_3$:

Rinse Water	ppm Hardness as $CaCO_3$		
Gallons	A	B	C
1	0	34	51
2	0	34	51
3	below 17	51	68

4	"	51	68
5	"	51	85
6	"	68	85
7	"	68	85
8	"	68	85
9	34	68	103
10	34	85	103
11	34	103	103
12	51	103	103
13	51	120	120
14	68	120	120
15	68	137	120
16	68	137	137
20	103	205	171
25	188	239	205
30	239	256	239
35	274		256

According to one embodiment of the invention, the ion exchange resin can comprise a mixture of anionic and cationic resins. A preferred cationic resin is Dowex Monosphere 550A available from Dow Chemical Company, a strong base anion exchange type deionizer having a styrene-DVB gel matrix and a quaternary amine functional group with a mean particle size of 530 to 630 microns. A preferred anionic resin is Dowex Monosphere 650C(H) available from Dow Chemical Company, a strong acid cation exchange type deionizer having a styrene-DVB gel matrix and a sulfonic acid functional group with a mean particle size of 600 to 700 microns. A 50/50 mixture of these two deionizers can remove enough hardness from the water typically found in suburban environments to sufficiently avoid filming and/or spotting after the rinsing step according to the invention. In general, it is desirable to remove

enough hardness from the water to reduce the hardness as expressed as $CaCO_3$ to below 30 ppm, preferably to below 25 ppm, and still more preferably to below 20 ppm. The amount of deionizer needed to rinse the windows of a home will depend on the hardness of the water and size of the home, e.g. 300 grams of deionizer for a large home and 100 grams of deionizer for a small home.

Cleaning performance of cleaning compositions in accordance with the invention (Armor All) was compared to cleaning performance of commercially available products sold under the names Bix, renz e-z and Windex Outdoor, with a rating of 0 on a scale of 0 to 4 indicating complete soil removal (as observed visually and by gloss meter) and 4 representing lack of soil removal. In the tests, the products were sprayed through a hose end sprayer onto exterior windows and rinsed off after about 1 minute. The results of these tests are set forth below:

Formula	Rating
Armor All	1
Bix	2
renz e-z	3
Windex Outdoor	3

Although the exact formulas of the Bix, renz e-z and Windex products are not known, Armor All included 58.4% water, 9% TKPP, 13.6% Versene 100, 2% Neodol 91-6, 2% Neodol 91-2.5, and 15% SXS-40. These tests showed that a highly built cleaner formula, when rinsed with purified rinse water, provided exceptional cleaning results compared to commercially available products.

The foregoing has described the principles, preferred embodiments and modes of operation of the present invention. However, the invention should not be construed as being limited to the particular embodiments discussed. Thus, the above-described embodiments should be regarded as illustrative rather than restrictive, and it should be appreciated that variations may be made in those embodiments by workers skilled in the art without departing from the scope of the present invention as defined by the following claims.

CLAIMS:

1. A cleaning composition for cleaning an exterior window by spraying an aqueous solution of the cleaning composition on the window, the cleaning composition comprising at least one builder and a cationic surfactant, the cationic surfactant being present in an amount effective to form an invisible film on the window which causes beading of purified rinse water sprayed onto the window to rinse the cleaning composition from the window.

2. The cleaning composition of Claim 1, wherein the cleaning composition is in solid form and contains (a) about 15 to about 60% by weight of tetrasodium EDTA; (b) about 15 to about 60% by weight of tetrapotassium pyrophosphate; (c) about 15 to 60% by weight of sodium carbonate; (d) about 2.5 to about 10% by weight of an ethoxylated surfactant; and (e) about 2.5 to about 10% by weight of the cationic surfactant.

3. The cleaning composition of Claim 2, comprising about 30% by weight of tetrasodium EDTA; about 30% by weight of tetrapotassium pyrophosphate; about 30% by weight of sodium carbonate; about 5% by weight of an ethoxylated alcohol surfactant; and about 5% by weight of an ethoxylated quaternary surfactant.

4. The cleaning composition of Claim 2, wherein the sodium carbonate is in low density form, the ethoxylated surfactant is an ethoxylated alcohol surfactant, the cationic surfactant is an ethoxylated quaternary surfactant, and the cleaning composition is in solid pellet form.

5. The cleaning composition of Claim 1, wherein the cleaning composition is in liquid form and contains (a) about 50 to about 95% by weight of water; (b) at least about 4% by weight of a detergent builder; (c) at least about 1% of a surfactant; and (d) at least 0.1% of a cationic surfactant.

6. The cleaning composition of Claim 5, comprising about 48 to 97% by weight of water; about 2 to 7% by weight on a dry basis of tetrasodium EDTA; about 1 to 20% by weight of tetrapotassium pyrophosphate; optionally about 1 to 20% by weight of a corrosion inhibitor; about 0.5 to 10% by weight of at least one ethoxylated alcohol surfactant; about 1 to 15% by weight on a dry basis of a coupling agent; and about 0.5 to 3% by weight of an ethoxylated quaternary surfactant.

7. The cleaning composition of Claim 5, wherein the surfactant comprises (i) a mixture of alcohols containing 9 to 11 carbon atoms with an average of 6 moles of ethylene oxide reacted onto the hydroxyl portion of the alcohols; and (ii) a mixture of alcohols containing 9 to 11 carbon atoms with an average of 2.5 moles of ethylene oxide reacted onto the hydroxyl portion of the alcohols.

8. A method for cleaning an exterior window surface free of spotting and/or filming, comprising spraying a cleaning composition through a hand held hose end spray gun onto the window surface to be cleaned, preparing purified rinse water by passing rinse water through a deionizer supported by the spray gun and rinsing the window surface with the purified rinse water.

9. The method of Claim 8, using a solid cleaning composition comprising (a) about 15 to about 60% by weight of tetrasodium EDTA; (b) about 15 to about 60% by weight of tetrapotassium pyrophosphate; (c) about 15 to 60% by weight of sodium carbonate; (d) about 2.5 to about 10% by weight of an ethoxylated surfactant; and (e) about 2.5 to about 10% by weight of a cationic surfactant, the solid cleaning composition being supported by the spray gun and being carried onto the surface to be cleaned by water passing through the spray gun.

10. The method of Claim 8, using a liquid cleaning composition comprising (a) about 50 to about 95% by weight of water; (b) at least about 4% by weight of a detergent builder; (c) at least about 1% of a surfactant; and (d) a cationic surfactant in an amount effective to cause beading of purified rinse water from a cleaned surface during spraying of the purified rinse water to the cleaning composition from the cleaned surface, the liquid cleaning composition being siphoned from a container supported by the spray gun and carried onto the surface to be cleaned by water passing through the spray gun.

11. The method of Claim 8, wherein the purified water is sprayed from the spray gun after passing through a series of flow passages containing an ion exchange resin so as to reduce the hardness of the water as expressed as $CaCO_3$ to below 30 ppm.

12. The method of Claim 11, wherein the purified water is sprayed from the spray gun after passing through a series of flow passages containing a mixture of a cationic exchange resin and an anionic exchange resin.

13. The method of Claim 11, wherein the ion exchange resin is contained in a deionizer cartridge removably attached to the spray gun.

14. The method of Claim 11, wherein the cleaning composition includes a rinse indicator, the rinsing step comprising spraying the purified rinse water on the glass surface until the rinse indicator causes the purified water to bead up on the glass surface.

15. A hand-held, hose-end spray gun for cleaning exterior window surfaces, the spray gun comprising:

a main body including a water supply passage, a mixing passage adapted to mix a cleaning composition with water passing through the mixing passage, a

deionizing passage and a valve, the valve being movable from a cleaning position to a rinsing position, the water supply passage being in fluid communication with the mixing passage when the valve is in the cleaning position and the water supply passage being in fluid communication with the deionizing passage when the valve is in the rinsing position; and

an ion exchange resin contained in the deionizing passage, the ion exchange resin effecting purification of water passing therethrough when the valve is in the rinsing position.

16. The spray gun of Claim 15, further comprising a deionizer cartridge, the deionizer cartridge including a series of flow passages containing the ion exchange resin and the deionizer cartridge being removably attached to the main body.

17. The spray gun of Claim 15, wherein the mixing passage includes an upstream passage and a downstream passage, the downstream passage having a larger cross section than the upstream passage, the main body including a supply passage opening into the downstream passage, the supply passage being adapted to supply liquid cleaning composition to the downstream passage via a closed venturi effect when water under pressure in the upstream passage enters the downstream passage, a container of liquid cleaning composition being removably attached to the main body and the container including a siphon tube in fluid communication with the supply passage.

18. The spray gun of Claim 15, wherein the deionizing passage includes a series of flow passages which are parallel to each other, the flow passages providing alternating directions of flow of water through the ion exchange resin.

19. The spray gun of Claim 16, wherein the flow passages are parallel to each other and extend in first and second directions, the flow passages extending in the first direction being larger in volume than the flow passages extending in the second direction, and substantially all of the ion exchange resin being located in the flow passages extending in the first direction.

20. The spray gun of Claim 15, wherein the main body includes a first outlet through which a mixture of cleaning composition and water is sprayed from the spray gun when the valve is in the cleaning position and a second outlet through which purified water is sprayed from the spray gun when the valve is in the rinsing position.

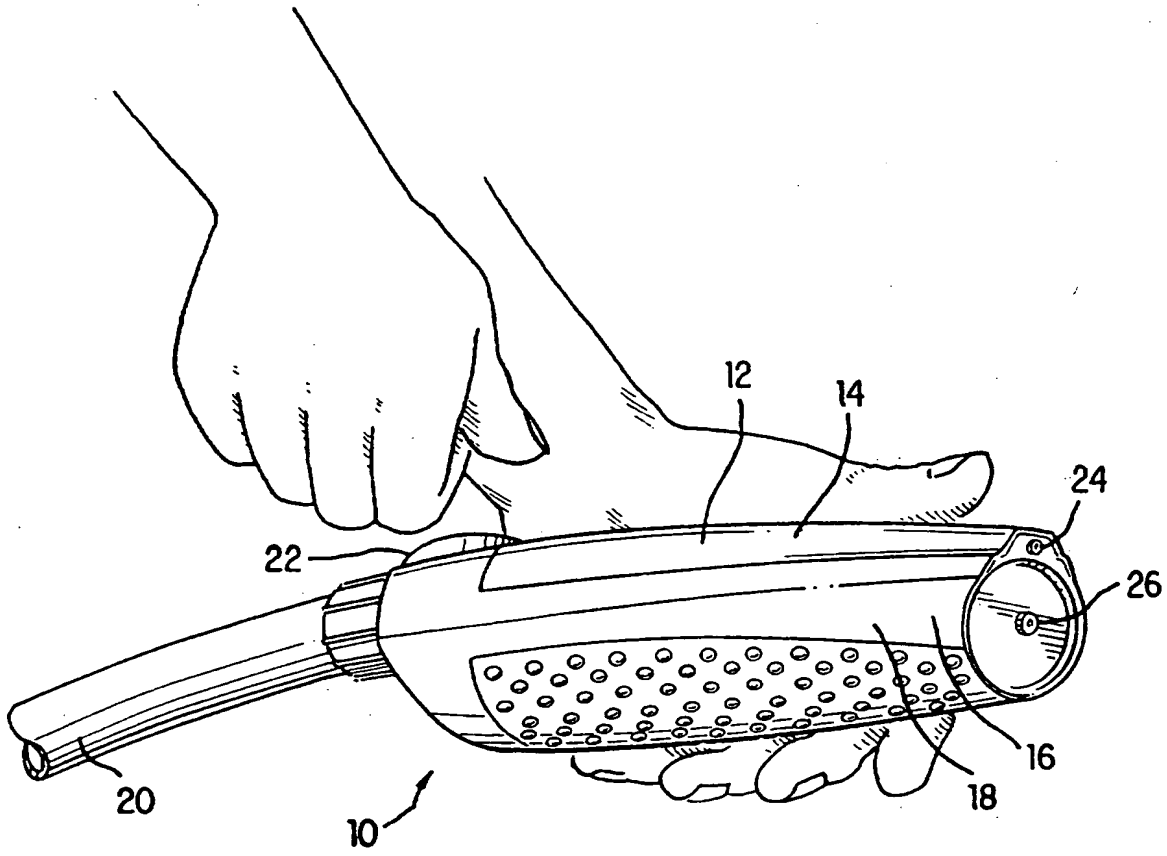

FIG. 1

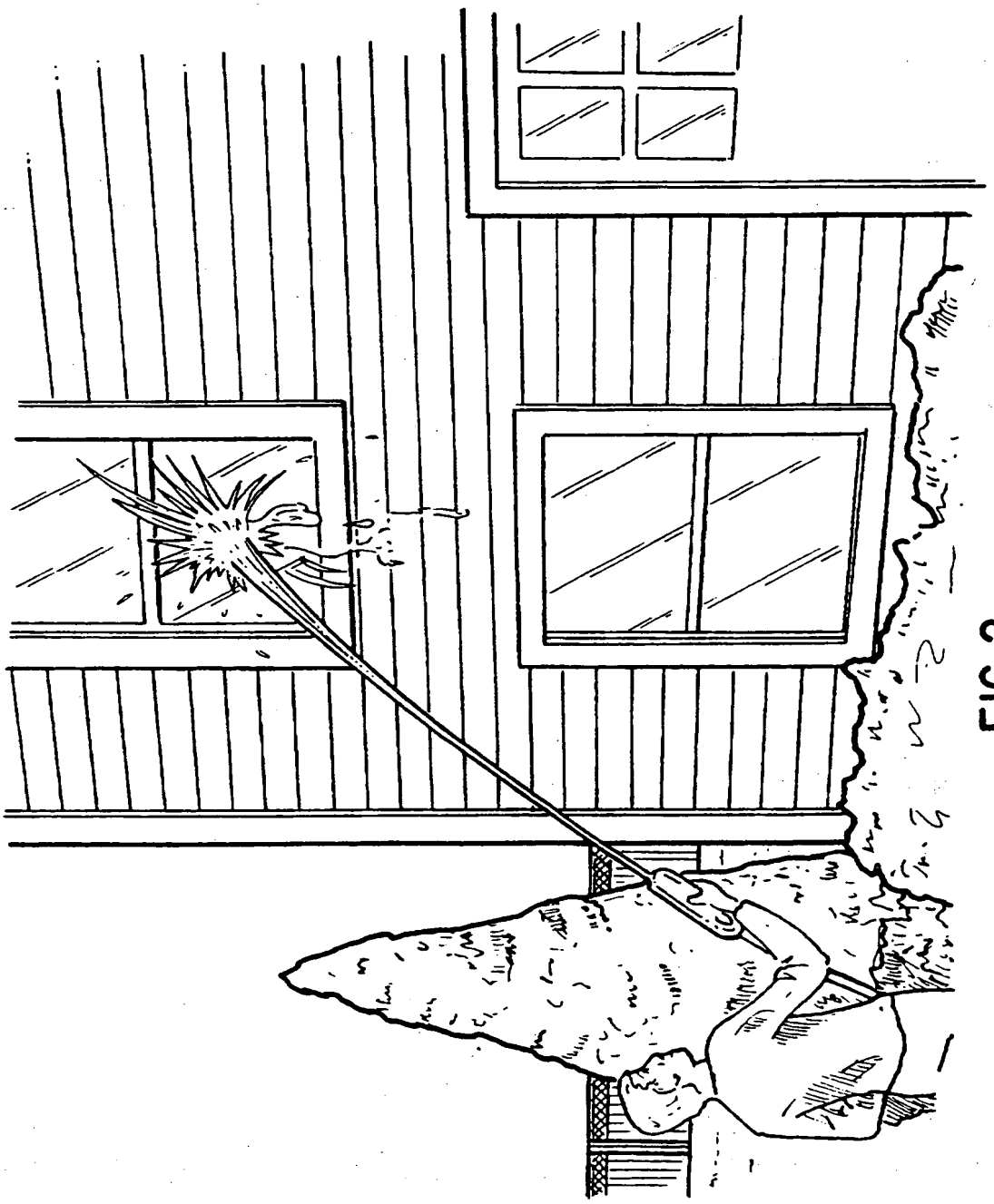

FIG. 2

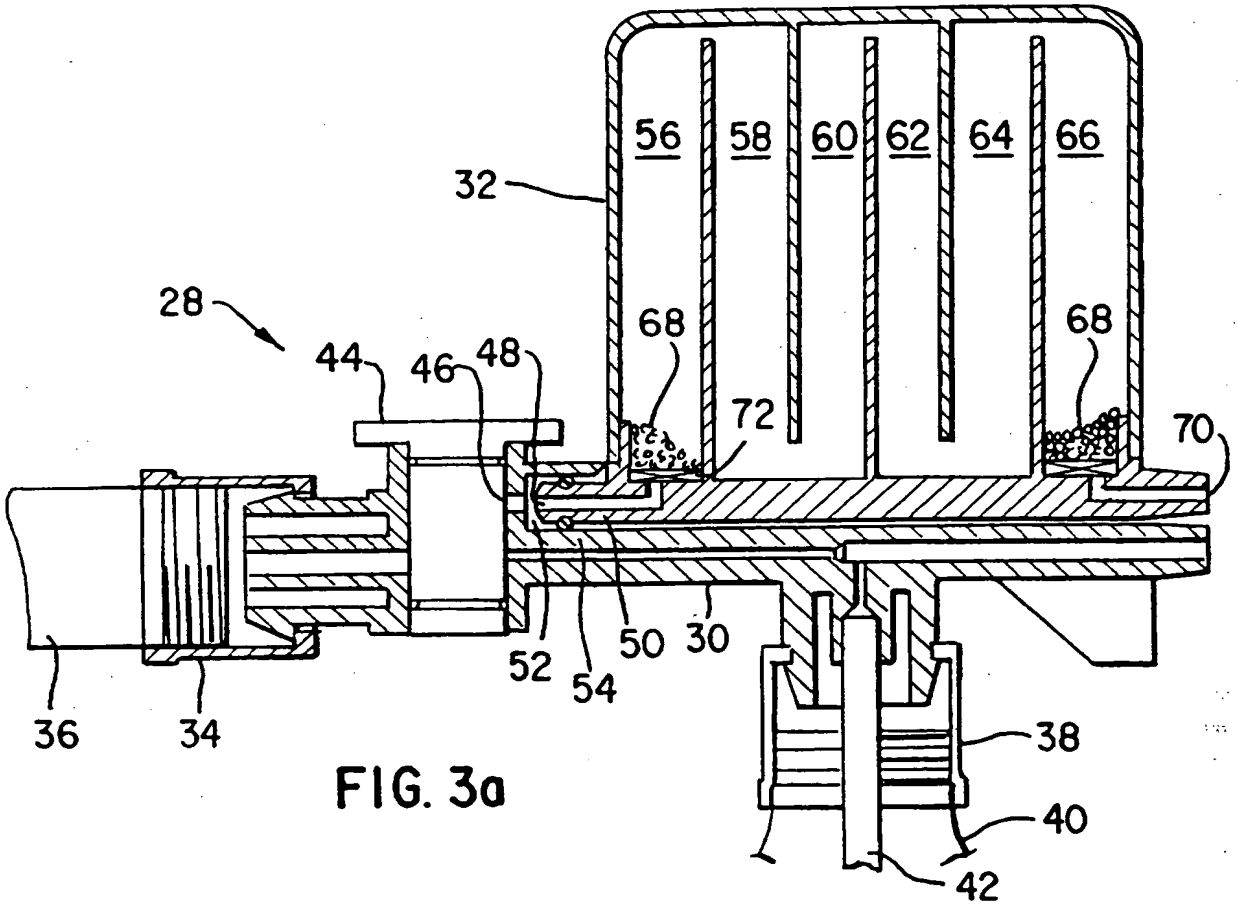

FIG. 3a

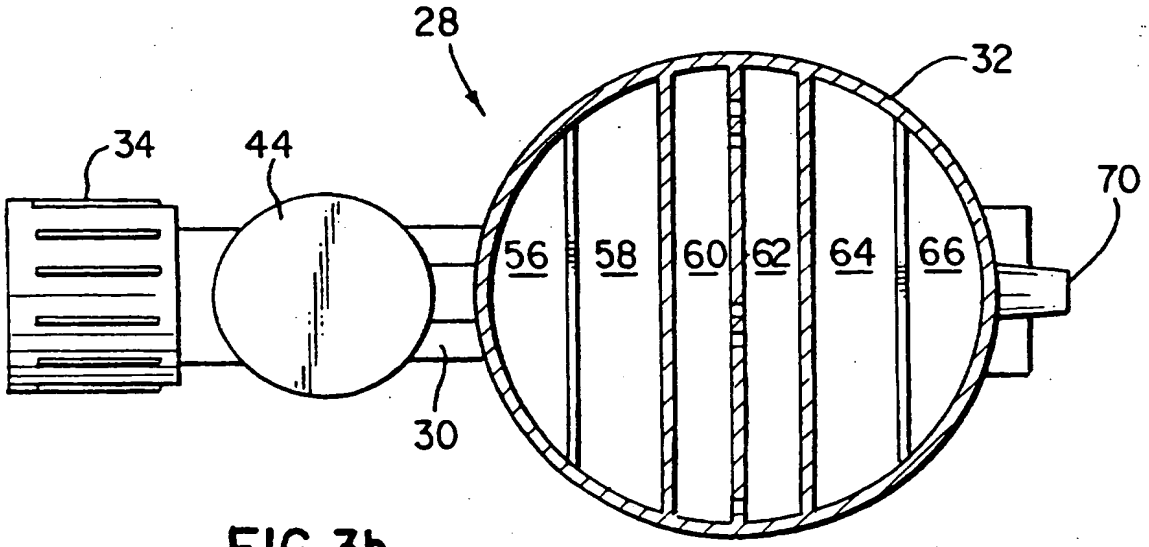

FIG. 3b

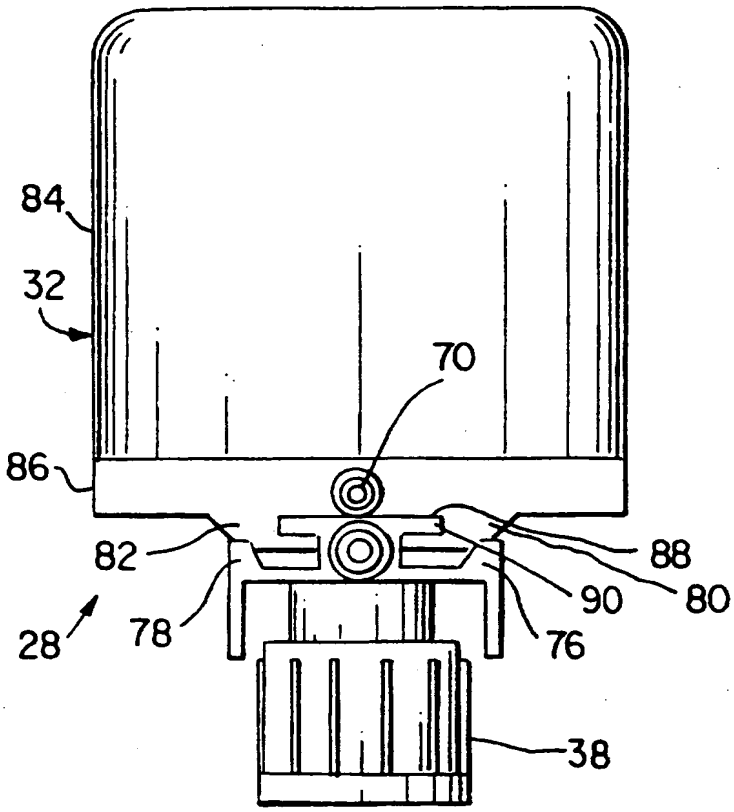

FIG. 3c

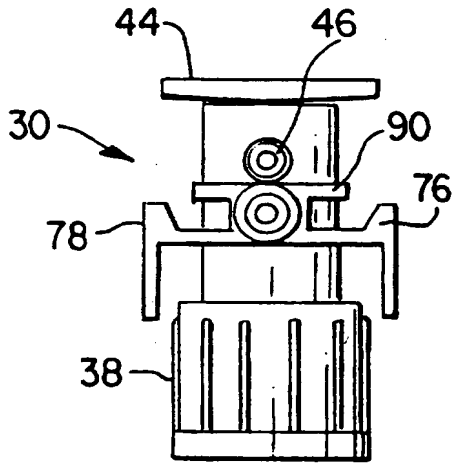

FIG. 4c

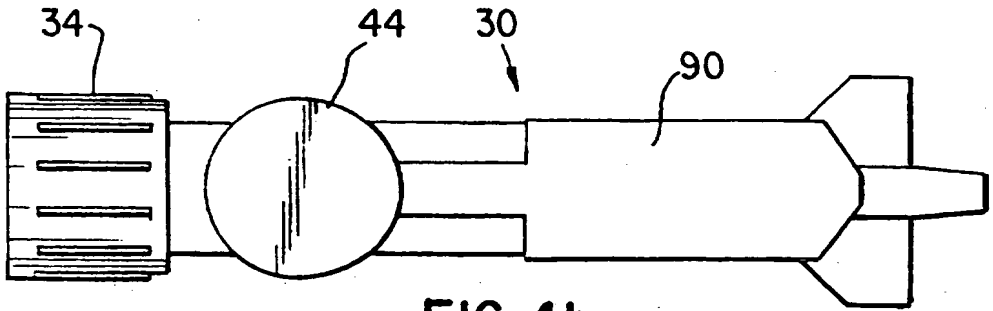

FIG. 4b

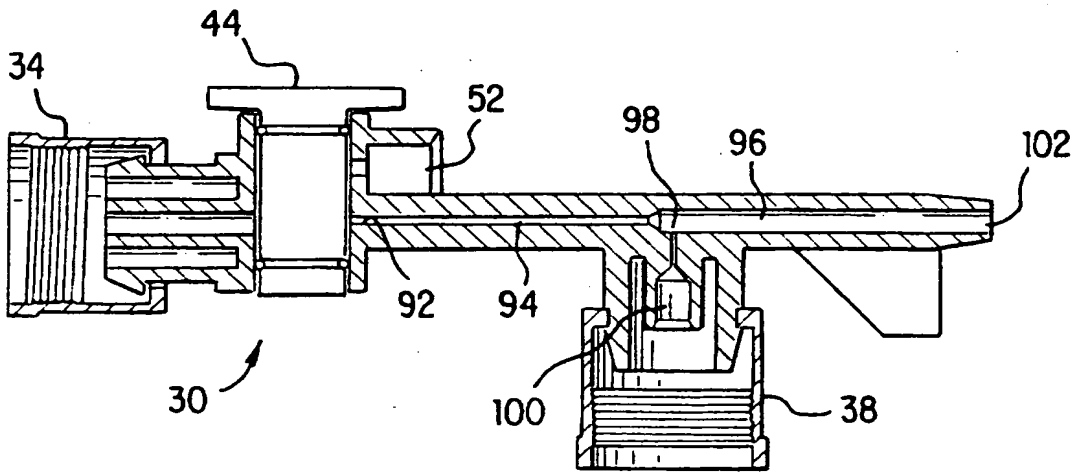

FIG. 4a

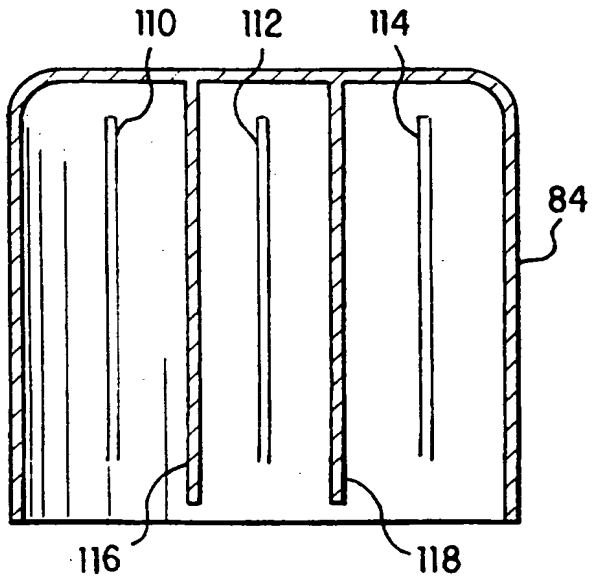

FIG. 5b

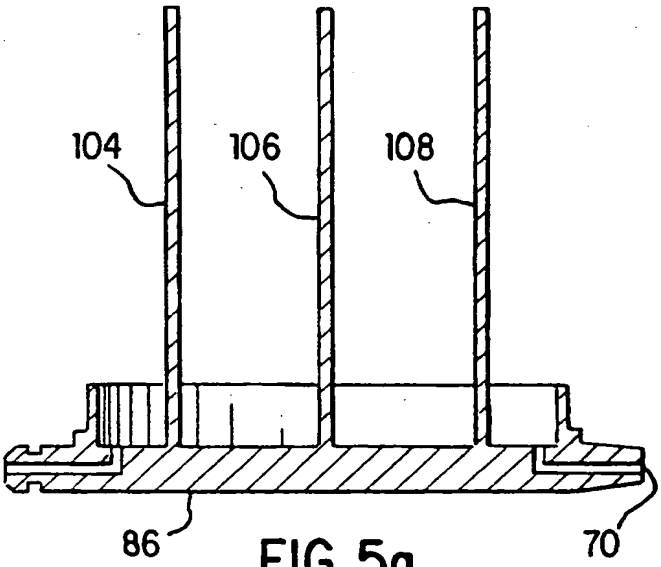

FIG. 5a

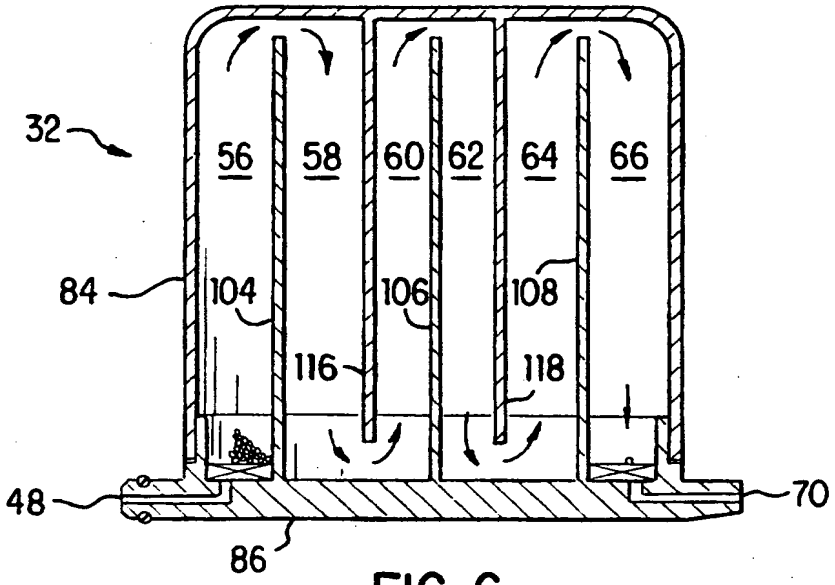

FIG. 6

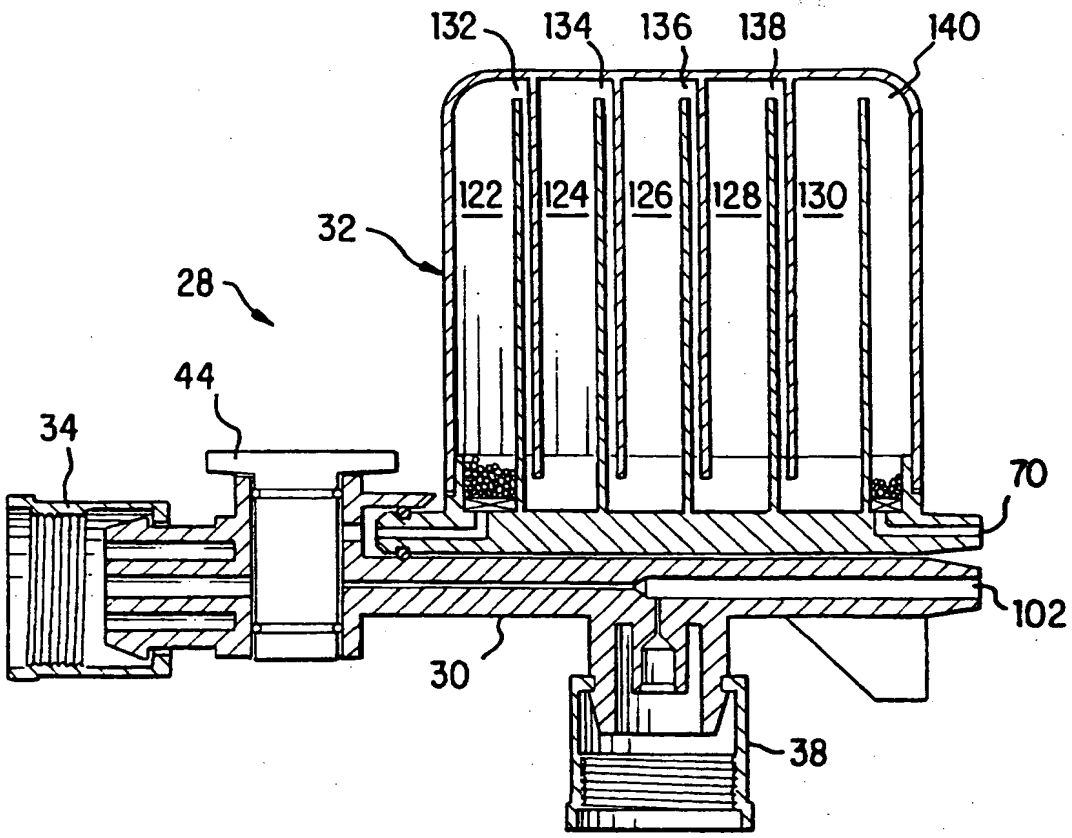

FIG. 7a

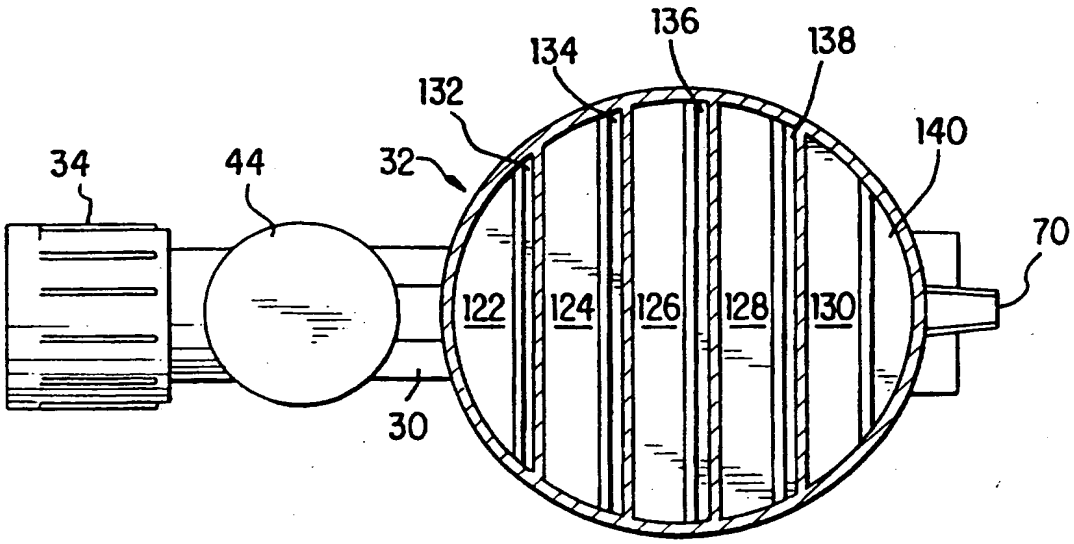

FIG. 7b

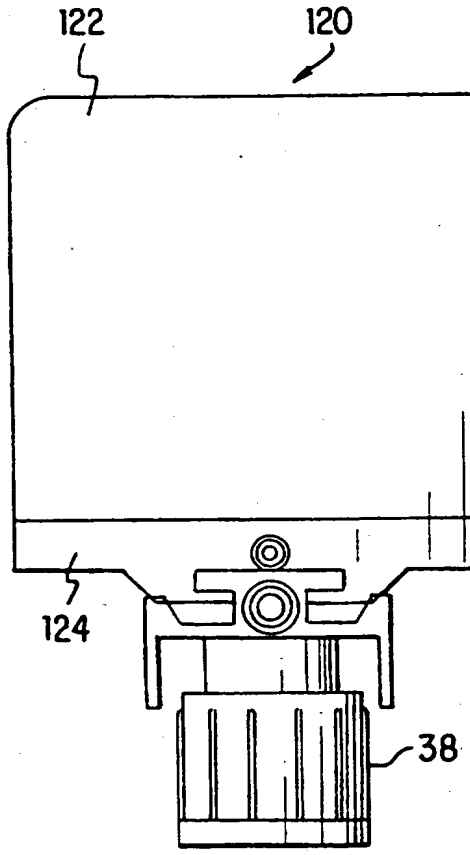

FIG. 7c

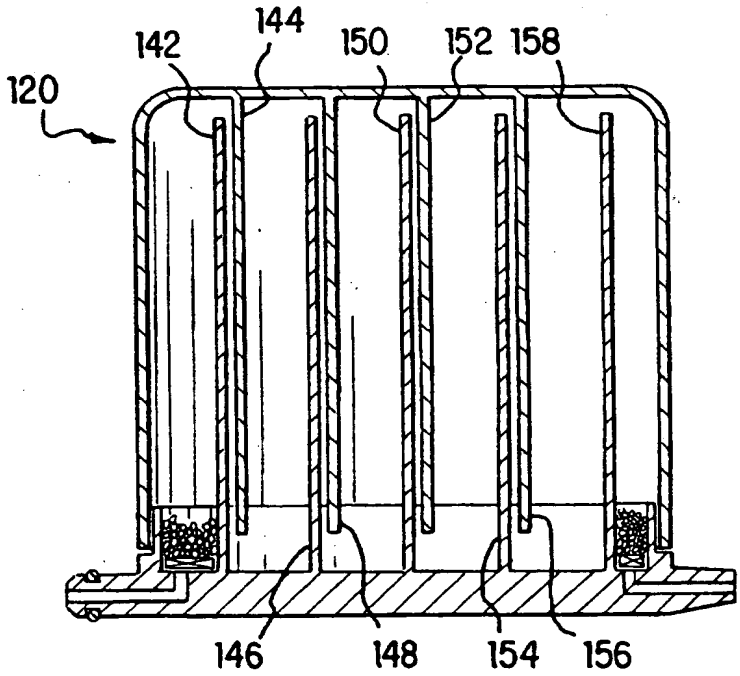

FIG. 8

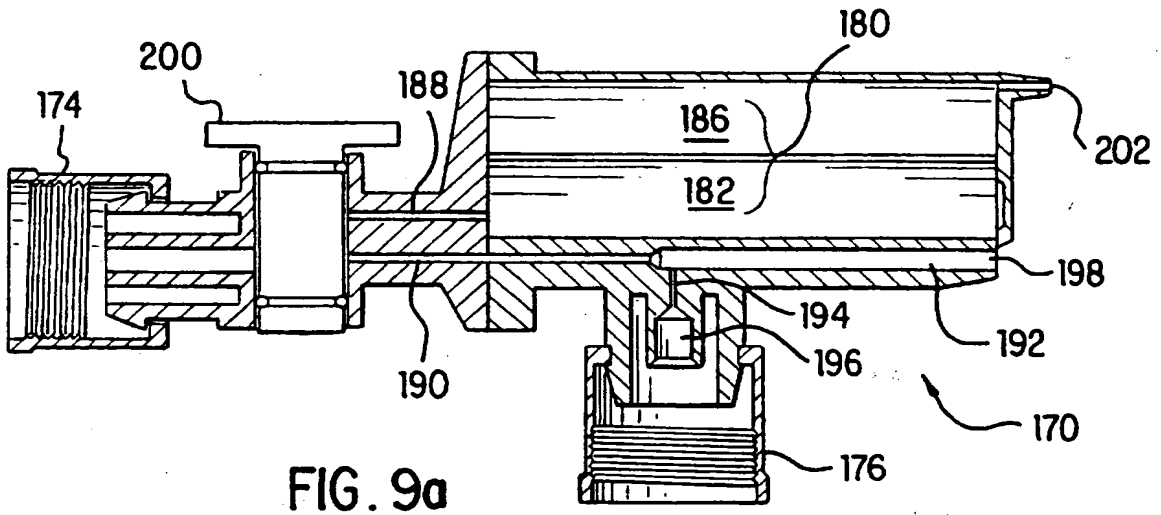

FIG. 9a

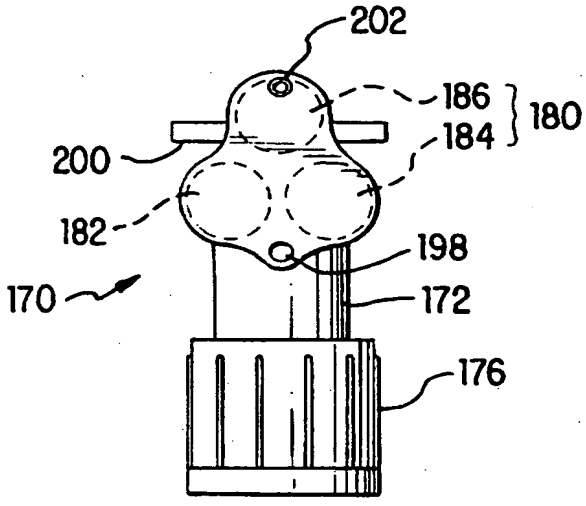

FIG. 9b

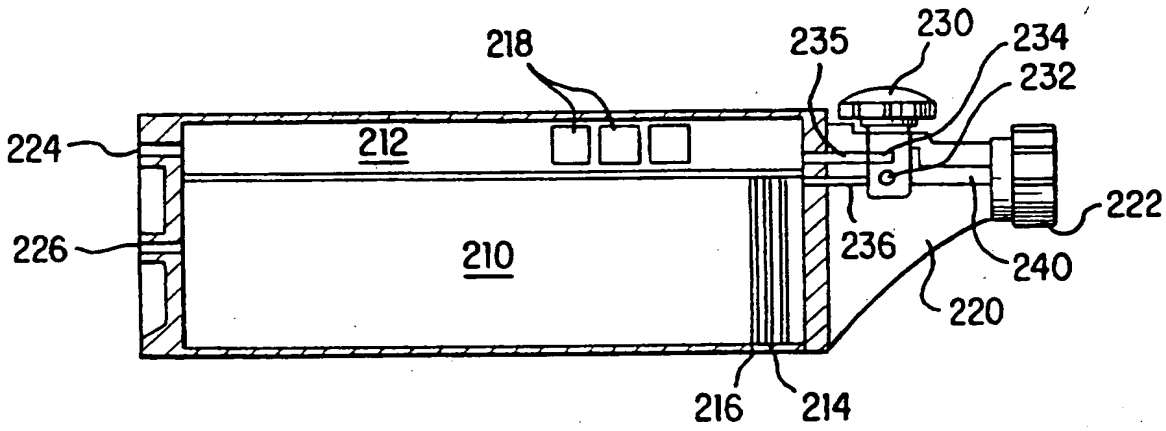

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12596

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :Please See Extra Sheet.
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 137/240, 246, 247; 239/304, 305, 310, 316, 396; 134/4, 29, 103.2, 103.3; 510/180, 181, 182, 243, 244, 245, 254, 255, 421, 423, 433.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,664,848 A (OH ET AL) 12 May 1987, abstract, column 5, line 34-column 6, line 65; column 28, lines 15-24 and 54-58; column 31, lines 8-60; column 33, lines 5-15; column 34, lines 30-56	1-7
X	US 4,347,168 A (MURPHY ET AL) 31 August 1982, abstract, column 2, lines 43-65; column 7, lines 59-66; column 8, lines 62-66; column 9, lines 14-25.	1-4
X	US 4,333,862 A (SMITH ET AL) 08 June 1982, abstract, column 1, line 65-column 2, line 12; column 3, lines 4-12; column 6, line 58-column 7, line 25; column 8, lines 60-63; column 9, line 64-column 10, line 4; column 10, lines 36-39; lines 49-68.	1, 5-7

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 16 OCTOBER 1997	Date of mailing of the international search report 14 NOV 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JOHN R. HARDEE Telephone No. (703) 308-0661

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12596

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,284,435 A (FOX) 18 August 1981, abstract, column 2, line 16-column 4, line 23.	1, 5, 7
A,P	US 5,605,578 A (HAWES ET AL) 25 February 1997, all.	8-20
A,P	US 5,595,345 A (CHURA ET AL) 21 January 1997, all.	8-20
A,P	US 5,587,022 A (BLACK) 24 December 1996, all.	8-20
A	US 4,967,960 A (FUTRELL) 06 November 1990, all.	8-20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12596

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/12596

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):

F16K 3/36, 13/00; A62C 5/02, 13/00 13/62, 31/02; B05B 7/26; B08B 3/00, 7/00; C11D 9/04, 17/00, 17/08.

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

137/240, 246, 247; 239/304, 305, 310, 316, 396; 134/4, 29, 103.2, 103.3; 510/180, 181, 182, 243, 244, 245, 254, 255, 421, 423, 433.

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

STN ONLINE
search terms spray gun#, nozzle#, cationic, quaternary, ethoxylate#, builder#, ion exchange, deionize#, deionise#, demineralize# demineralise#

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claim(s)1-7, drawn to a cleaning composition, and claim(s) 8-14, drawn to a method of cleaning.

Group II, claim(s) 15-20, drawn to a spray gun.

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The inventions of each group do not share a "special technical relationship" with each other. That is, Group I is to a cleaning composition containing at least one builder and a cationic surfactant which causes a film to be formed on a window for beading rain, and a method of cleaning windows by spraying the cleaning composition then purified water utilizing a hand held spray gun having a deionizer supported thereon. Group II is drawn to a hand-held spray gun having a main body and mixing passage for mixing a cleaning composition with water, and deionizing passage with a valve and ion exchange resin therein.